# Subsistence, Settlement, and Social Stratification on the Great Hungarian Plain During the Transition to the Copper Age

Honors Research Thesis

Presented in partial fulfillment of the requirements for the graduation *with honors research distinction* in Anthropology in the undergraduate colleges of The Ohio State University

By

Kyra Pazan

The Ohio State University
October 2013

Project Advisor: Professor Richard Yerkes, Department of Anthropology

## Table of Contents

**Abstract**

This thesis concerns hunting and animal domestication during the Late Neolithic (5000-4500 BC cal) and Early Copper Age (4500-4000 BC cal) on the Great Hungarian Plain. Intensively occupied tell sites and other surrounding flat areas characterized the landscape of the Carpathian Basin during the Late Neolithic. During the Early Copper Age, most tell sites were abandoned as farmers moved to more widely dispersed settlements. Faunal data from Szeghalom-Kovácshalom and Vésztő-Mágor, two Late Neolithic sites, shows that hunting was more prevalent on tells than surrounding flat sites. Additional analysis of the Early Copper Age sites of Vésztő-Bikeri and Körösladány-Bikeri shows that the intensity of hunting and the occupation of tell sites declined simultaneously during the Early Copper Age. The variation in the faunal assemblages of flat and tell sites during the Late Neolithic can be attributed to a social hierarchy in which hunting was a luxury of the tell populations. Additionally, the decline of hunting and dissolution of tells in the Early Copper Age is evidence of a rejection of that social hierarchy.

## Acknowledgements

Without the National Science Foundation International Research Experiences for Students Program and the Körös Regional Archaeological Project, I never would have had the opportunity to engage in the fieldwork that is the basis for this thesis. Thank you to all the people involved in KRAP who taught me how to excavate, process materials in the lab, and most importantly, to think. Through your guidance and patience, I've learned an enormous amount and have discovered my passion for archaeology. I am constantly humbled by your knowledge and experience. Thank you to Dr. Attila Gyucha and the rest of the Hungarian team for welcoming me into your country, trying your best to teach me some of your language, and making me feel at home. Thank you, Dr. William Parkinson, for pushing me to ask questions. Thank you to my parents for always being on the other end of the phone line, to Erin Blankenship-Sefczek, Tim Sefczek, and Dr. Paul Duffy for your guidance, to Kelsey Bisson for your friendship and support, and to all the professors I have had the privilege of learning from at Ohio State, in particular Drs. Scott McGraw and Clark Spencer Larsen. Your lectures and enthusiasm never fail to inspire me. And finally, I owe an enormous amount to Dr. Richard Yerkes, my advisor, professor, and mentor. I cannot thank you enough for your inexhaustible patience and the time and support you invested in me, teaching me to identify bones, reading my rough drafts, and never failing to answer a panicky email. I couldn't have made it through fieldwork, let alone this thesis, without you.

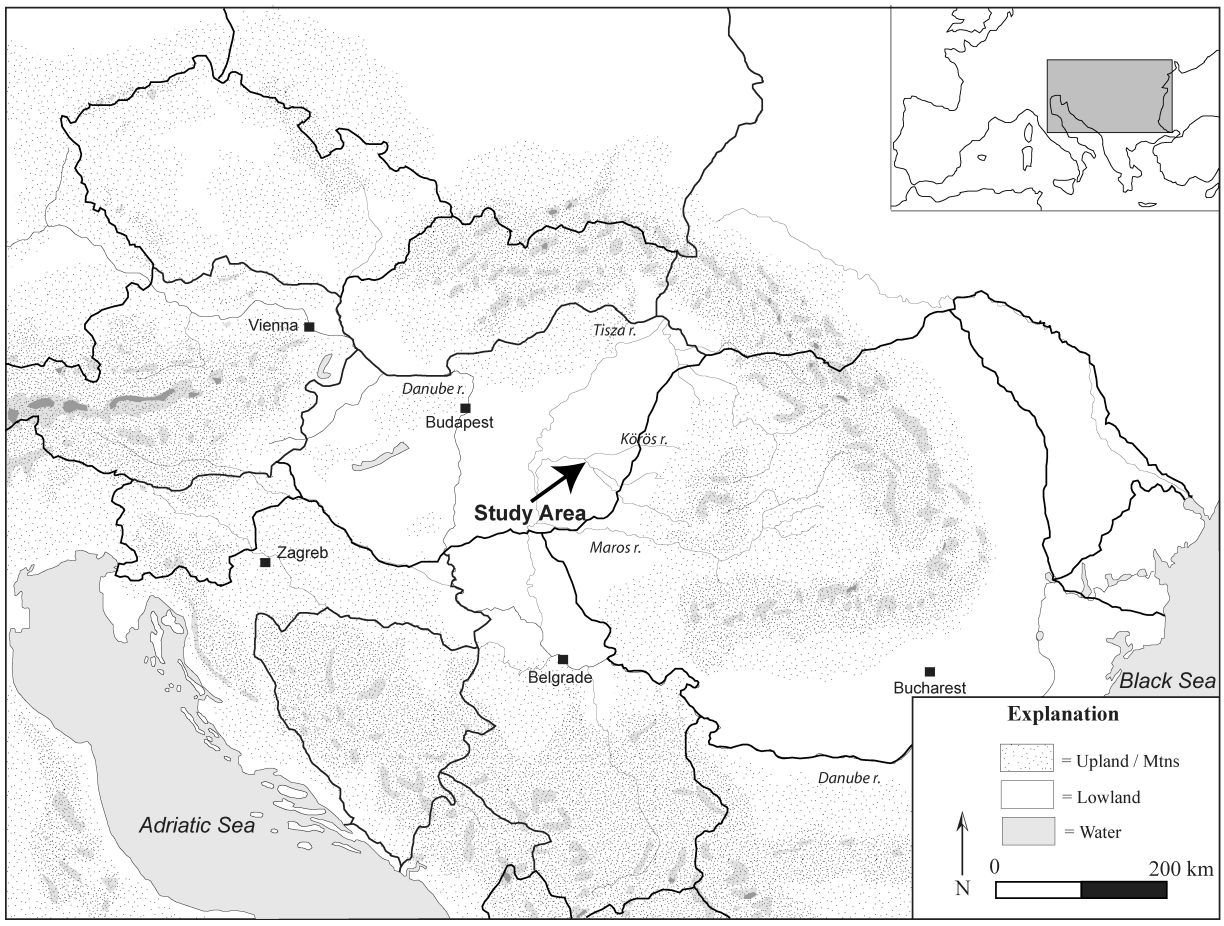
## I. Introduction

The Great Hungarian Plain, or *Nagy Alföld*, blankets an expanse of 52,000 $km^2$ from the Danube to the Carpathian Mountains in modern day Hungary. It is home to a rich archaeological record from the Paleolithic through the origins of European agriculture to the present. Previous studies (Parkinson 1999, Giblin 2011, Yerkes et al. 2009, Bartosiewicz 2005) have uncovered changes in lifeways between the Late Neolithic (5000-4500 BC cal) and the Early Copper Age (4500-4000 BC cal), notably changes in subsistence and settlement patterns, burial customs, and ceramic styles.

One aspect of the Neolithic-Copper Age transition is the process of tell formation and abandonment. During the Middle Neolithic (5400-5000 BC calibrated), the residents of the Great Hungarian Plain left their flat, dispersed settlements and moved to larger sites that they occupied for generations, building new wattle and daub structures on top of old ones to create artificial hills of cultural material. These tells, rising meters above the landscape, were located near major rivers in the Carpathian Basin throughout the Late Neolithic. They were abandoned during the transition to the Early Copper Age. The Körös Regional Archaeological Project (KRAP), a collaborative venture comprised of American, Greek, Hungarian, and Canadian archaeologists, was established in 1998 to investigate the processes of tell formation and abandonment (Yerkes and Parkinson 2013).

During the spring of 2013, I was selected to travel to Hungary with the Körös Regional Archaeological Project, funded by the National Science Foundation International Research Experiences for Students Program. While in Hungary, I assisted with the excavation of the Szeghalom-Kovácshalom site and cleaned, identified, and cataloged 897 faunal remains collected during the 2013 field season. These remains in combination with the other remains

**Figure 1 Map of the Körös Regional Archaeological Project Study Area (Yerkes and Parkinson 2013)**




collected from Szeghalom-Kovácshalom during the previous two field seasons constitute the focus of this thesis. Based on a comparative study of the faunal data from Szeghalom-Kovácshalom and other Late Neolithic and Early Copper Age sites, and the examination of other archaeological correlates of social ranking, it is proposed that their was some limited social differentiation in the societies on the Great Hungarian Plain during the Late Neolithic period. However, this social differentiation disappeared altogether in the Early Copper Age when smaller, autonomous, interdependent communities were established after the abandonment of the large tell-centered settlements.

## II. The Geographic and Archaeological Setting

*Geography*

A sandy area between the Danube and Tisza rivers separates the western reaches of the Great Hungarian Plain from Transdanubia. This region represented a geographic and cultural boundary. Numerous rivers that had formed during the Pleistocence wind across the plain, including the large Tisza River, which flows west and south from its source in Ukraine. Today, the Plain floods frequently, moistening its marshy and extremely fertile soils. These soils and sediments provided an ideal habitat for early agricultural populations to thrive during prehistory. Indeed today, much of the Plain is still devoted to farming (Parkinson 1999).

A reconstruction of the paleoenvironment of the Great Hungarian Plain by Gyulai (1993) is based on analysis of pollen from core samples. During the Early Neolithic, the Carpathian Basin was characterized by mixed oak forests and loess soil. In the Late Neolithic, a cooling trend accompanied the formation of large deciduous forests characterized by a predominance of beech trees. This cooling trend continued into the Copper Age. Today the Great Hungarian Plain sits at the northern edge of the Mediterranean climate zone, characterized by a relatively temperate climate (Parkinson 1999).

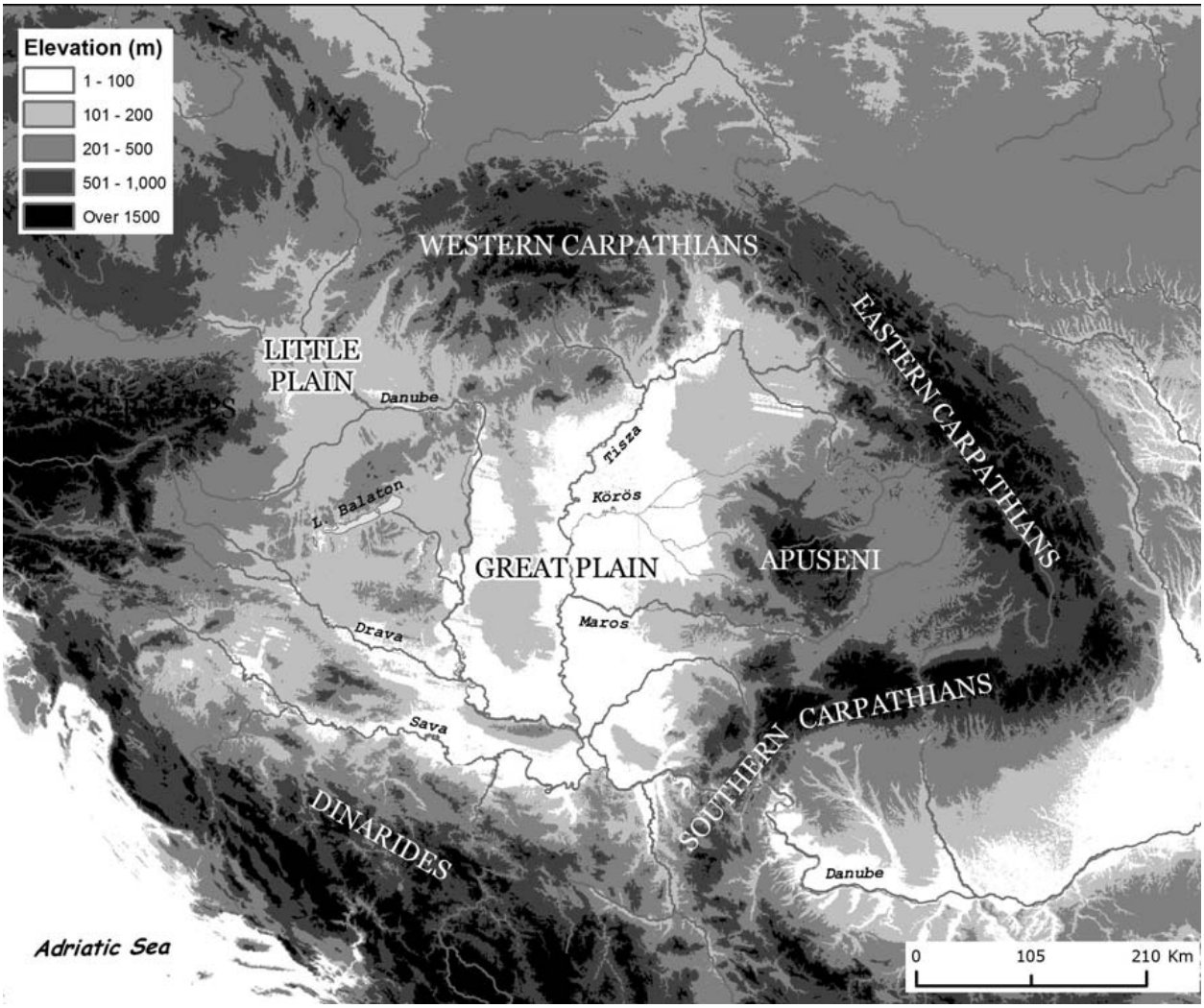
*Cultural History*

The Early Neolithic (6000-5400 BC calibrated) on the Great Hungarian Plain was dominated by the Körös culture, an early agricultural society that moved north up the Balkans onto the plain (Parkinson 1999). Some of these Early Neolithic populations lived near Mesolithic hunter-gatherer populations, separated only by climatic boundaries.

> The Mesolithic sites in the Alföld lie in the well-watered alluvial plain… and in sand regions on the dune ridges associated with marginal floodplains and water-courses… In other words, the Mesolithic sites lie in ecological niches which were rejected by the Körös culture. The Körös culture preferred levees suitable for agriculture. This is the

main reason why Mesolithic and Early Neolithic Körös groups lived side by side for a long period of time in the Alföld (Kertesz 1996:25).

**Figure 2. Map of the Carpathian Basin and surrounding area (from Duffy 2010:79)**




Based on evidence from faunal, burial and ceramic assemblages, the Körös people were Balkan migrants who brought their subsistence practices with them from the south. Approximately 89% of Early Neolithic faunal assemblages consist of domestic animals. Sheep and goats, which are not native to the Carpathian Basin, predominate. These animals were brought with the Körös people on their journey north (there were no wild sheep or goats in this region) (Bánffy 2004:57; Whittle 1996:52). The Köros people probably also brought domesticated wheat and barley with them from the south. Recent DNA analysis confirms that these plants and animals were not

domesticated in southeast Europe, but were domesticated in the Near East (Wilcox 2005, Beja-Pereira 2006; Bradley 2006; Cymbron 2005; Edwards 2007; Fernández et al. 2006; Luikart et al. 2006; Naderi et al. 2008). The domestic pig, however, constitutes an exception. Although domestic pigs originally came to Europe via the Near East, the Near Eastern stock was replaced and hybridized with wild boar domesticated in Europe (Larson et al. 2005, 2007). The Körös culture preferred the southern half of the Plain, avoiding the cooler air and wetter soils of the northern Plain above the "Central European-Balkanic agro-ecological barrier," which were less suitable for agriculture (Kertész and Sümegi 2001:236). Additionally, the Mesolithic populations on the northern half of the Plain may have limited the geographic expansion of the Körös farmers (Giblin 2011:34, Makkay 1996:41).

The Alföld Linear Decorated Pottery Culture (AVK) dominated the early phases of the Middle Neolithic period (5400-5000 BC cal) and not only exploited different environments than the Early Neolithic Körös culture, but also different resources (Giblin 2011). Late Early Neolithic populations broke the geographic and cultural barrier that separated the Körös culture from the Mesolithic populations of the northern plain and precipitated the formation of the Early Middle Neolithic Szatmár culture, a proto-AVK culture (Kertész and Sümegi 2001:237; Whittle 1996:85). Thus the birth of the AVK may have been the result of interaction between the Early Neolithic Körös culture and the indigenous Mesolithic hunter-gatherer populations (Bánffy 2004:54). Mesolithic populations in the Jászság area (northern Great Hungarian Plain) lived in very close proximity to Körös populations, which may have led to "bi-directional cultural and environmental adaptation," resulting in the adoption of agriculture by the Mesolithic populations and the adaptation of the Körös culture to the resources of the Carpathian Basin (Kertész and Sümegi 2001:237).

This cultural diffusion model may explain some of the differences between the AVK and Körös cultures. For example, the AVK relied more heavily on domesticated animals than the Körös culture, and particularly on cattle and pig (Parkinson 1999, Bartosiewicz 2005). Additionally, the frequency of sheep and goats declined in the Middle Neolithic, reflecting the abandonment of Balkan animal husbandry traditions and a shift to usage of the faunal resources of the Carpathian Basin. Domesticated plant use also increased in the Middle Neolithic. Domesticated plants were probably introduced to southeast Europe by way of Anatolia and the Near East, but this is still up for debate (Giblin 2011:22).

During the Middle Neolithic, tell sites begin to emerge around Europe. These tell sites were occupied through the Late Neolithic (5000-4500 BC calibrated), an era which brought with it additional changes in culture and subsistence patterns. During the Late Neolithic, three cultural "clusters" emerged: the Tisza, Herpály, and Csöszaholm. These cultures are defined by their ceramic styles, subsistence patterns, and settlement patterns. The Late Neolithic inhabitants of the Szeghalom-Kovácshalom tell and surrounding flat sites, the focus of this thesis, were part of the Tisza cultural tradition (Giblin 2011; Kalicz and Raczky 1987; Parkinson 1999). There are, however, three types of settlements recognized in the Carpathian Basin in the Late Neolithic: (1) tell settlements, (2) tell-like settlements occupied less intensively, and (3) single layer sites (Kalicz and Raczky 1987). Late Neolithic peoples lived in rectangular houses with plastered floors and continued to follow many of the subsistence trends established in the Middle Neolithic. Cattle and domestic pig continued to grow in importance while the significance of sheep and goat declined. Common wild species found in faunal assemblages include aurochs, wild boar, and cervids (Parkinson 1999). Although domestication was prevalent during the Late Neolithic, hunting also played an important role in subsistence. Game may have contributed as

much of 23-48% of the meat in the Tisza culture's diet (Kalicz and Raczky 1987:24; Kovács and Gál 2009:151-152). A marked increase of aurochs, wild boar, and red deer exploitation in the Late Neolithic exemplifies this trend (Bartosiewicz 2005:60; Kovács and Gál 2009:151). Incidentally, hunting reemerged in the Carpathian Basin simultaneously with the peak of tell occupation. Further investigation of this relationship could illuminate patterns of social and settlement structure during the transition to the Copper Age.

During the Early Copper Age (4500-4000 BC calibrated), the areas occupied by the Tisza-Herpály-Csőszhalom culture complex were inhabited by a more uniform culture complex distributed across the entire Great Hungarian Plain, the Tiszapolgár culture. Rather than occupying tells continuously for generations and living together in large groups, the Tiszapolgár agropastoralists occupied settlements for shorter periods of time, built smaller structures, and may have been more mobile than the Tisza-Herpály-Csőszhalom farmers of the Late Neolithic period (Giblin 2011). Yerkes *et al*. (2009) estimate that Late Neolithic tell sites were occupied on average 300-350 years, whereas Copper Age sites were only occupied for one or two generations maximum. The importance of domesticated animals increased during the Early Copper Age, and game contributed significantly less to diet (Giblin 2011, Parkinson 1999). Cattle contributed the greatest portion (by weight) of meat in the diet of the Tiszapolgár groups, but pigs, sheep, and goats were also raised in significant numbers (Giblin 2011).

Through the study of Szeghalom-Kovácshalom and additional sites, this thesis evaluates the differences in faunal assemblages between the Neolithic and Copper Age and extends our understanding of the complex relationships between subsistence and settlement structure. Table 1 above provides a quick summary of the primary differences between the Late Neolithic and the Early Copper Age agricultural groups.

**Table 1. Evidence for transition from Neolithic to Copper Age. Adapted from Sherrat (1997; Table 10.2)**

| Time Period | Cultures | Settlement | Subsistence | Material Culture | Exchange | Mortuary Practice |
|---|---|---|---|---|---|---|
| Late Neolithic (ca. 5000-4500 BC) | Tisza-Herpály-Csőszhalom | Large aggregated settlements w/ditches | Domestic cattle predominate; wild cattle locally important; cereals, wild species more abundant than in Middle Neolithic | Elaborately decorated pottery and cult objects in local styles | Large quantity and variety of imported materials (obsidian, flint, greenstone, grinders, imported fine pottery) | Small groups of graves in and around abandoned areas of settlement |
| Early Copper Age (ca. 4500-4000 BC) | Tiszapolgár | Dispersed, small settlements w/ditches | Domestic cattle predominate; cereals, wild species decline in abundance | Plain pottery w/o local styles; no figurines; metallurgy (copper and gold) on edge of Plain | Some obsidian, greenstone; occasional extra-Carpathian exports (esp. on edge of Plain) | Large, formal cemeteries isolated from settlements; burial in and around settlements |

## III. Site Descriptions

Faunal remains from four sites will be analyzed in this thesis: two Early Copper Age sites, Vesztő-Bikeri and Körösladány-Bikeri, and two Late Neolithic sites, Vésztő-Mágor and Szeghalom-Kovácshalom. These results will be compared with published data from twelve Late Neolithic sites that were combined and analyzed by Dr. László Bartosiewicz (2005).

*Vésztő-Mágor*

The Vésztő-Mágor tell is located on the left bank of a defunct meander loop of the Holt (old)-Sebes Körös River, which surrounded the tell on three sides during the Neolithic and Copper Age. The tell covers an area of approximately 4.25 hectares and rises nine meters above the river. Vésztő-Mágor was first occupied during the Middle Neolithic by the Szakálhát culture farmers and then continuously by Late Tisza culture groups until ca. 4500 B.C. The tell was

abandoned at the transition to the Early Copper Age and experienced reoccupations at other times throughout prehistory and history (Parkinson 1999).

Excavations of Vésztő-Mágor began in the 19th century and continued throughout the 1980s (Hegedűs and Makkay 1987). Hegedűs's excavations during the 1970s provide the faunal data analyzed here, identified by Ohio State student Jackie Lipphardt. The faunal data from these excavations includes specimens from the Middle and Late Neolithic, as well as the Copper and Bronze Ages and modern times. It does not, however, include floatation samples. Therefore the smaller fauna, fish, birds, and shellfish may be underrepresented in Hegedűs's sample. However, because floatation samples from Szeghalom-Kovácshalom are not included in the faunal sample analyzed in this study, the two assemblages are comparable. Hegedűs sorted the faunal material by cultural period. My analysis only includes the data she described as "Neolithic."

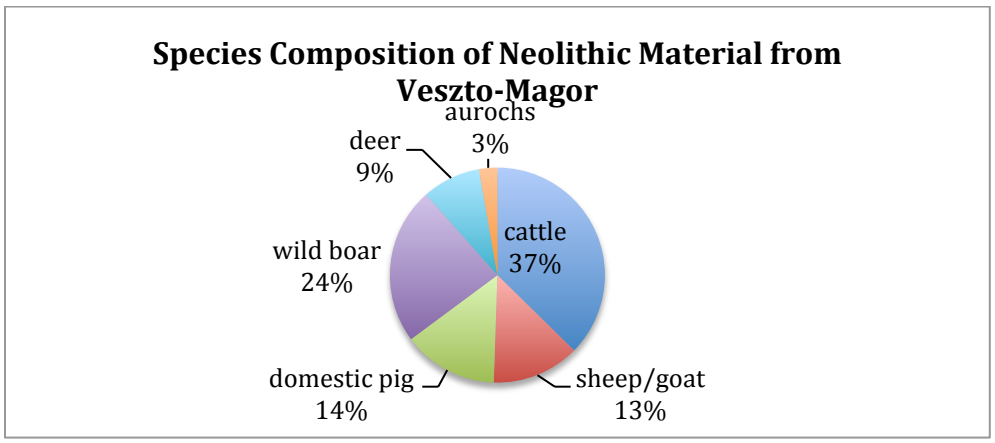
**Table 2. Species Composition of Vésztő-Mágor tell (NISP=182)**

| Species | NISP | Percent |
|---|---|---|
| Cattle | 68 | 37% |
| Sheep/goat | 24 | 13% |
| Domestic pig | 26 | 14% |
| Wild boar | 43 | 24% |
| Deer | 16 | 9% |
| Aurochs | 5 | 3% |
| Total | 182 | |

Overall, there were 1473 faunal specimens collected during Hegedűs's excavations in the 1970s. Of these, 224 are Neolithic. For the purposes of my analysis, I chose to focus on six species: domestic cattle, sheep/goats, domestic pig, wild boar, deer, and aurochs. These species are the most common in all of the assemblages in this study. They were also used by Dr. László Bartosiewicz in his more extensive study (2005). They make up 182 of the 224 specimens.

Overall, domestic cattle comprise the largest number of specimens (37%), followed by wild boar (24%). The distribution of species is shown in Table 2 and Figure 3.

**Figure 3. Species Composition of Vésztő-Mágor tell (NISP=182)**




*Vesztő-Bikeri and Körösladány-Bikeri*

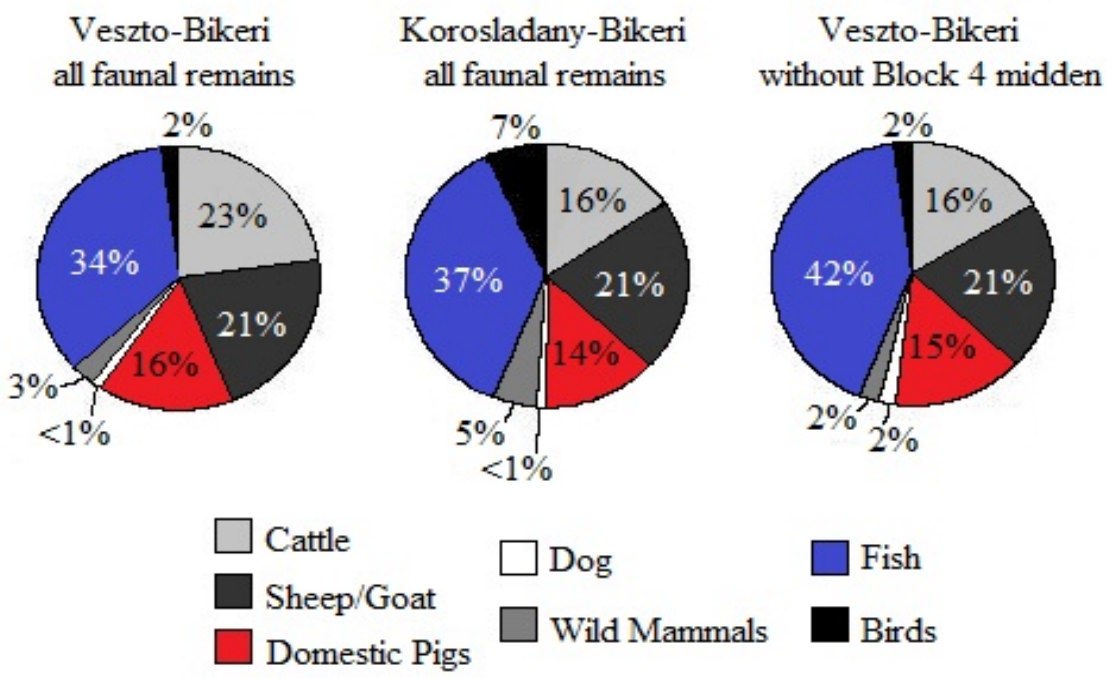
Vesztő-Bikeri is located north of what was once a meander of the Holt-Sebes-Körös, just across a modern canal from the Körösladány-Bikeri site. The two sites may have been occupied by the same Tiszapolgár agropastorlists, with some overlap of site use. Recent studies of radiocarbon dates from the two sites suggest that that the construction of Körösladány-Bikeri, which was slightly younger than Vesztő-Bikeri, began before the older site was completely abandoned, and that some timbers and structures were reused at the younger site (Yerkes et al. 2009). Therefore, data from both sites will be combined in this thesis. Faunal remains from both sites were collected by the Körös Regional Archaeological Project between 2000 and 2006 and today remain the only systematically collected faunal remains associated with the Early Copper Age Tiszapolgár culture. The sites date to 4600-4200 BC calibrated.

The faunal material from Vesztő-Bikeri was primarily identified by Amy Nicodemus while Richard Yerkes and several OSU field school students identified some additional material, including small fragments recovered during flotation processing. Almost 35,000 faunal

specimens were collected from the Vesztő-Bikeri site, of which 22,618 were studied. Because this study is only concerned with the frequencies of domestic cattle, sheep and goats, domestic pigs, wild boar, deer, and aurochs over time and space, I will not discuss the non-mammalian material collected at either Vesztő-Bikeri or Körösladány-Bikeri. 11,493 of the fragments from Vesztő-Bikeri were identified as mammalian, and only 2,985 of these were identified to genus or species. Of these, 94% of the specimens came from domesticated animals and only 6% came from wild animals.

The faunal material from Körösladány-Bikeri was found to be relatively similar to that from Vesztő-Bikeri. It was primarily identified by Hungarian zooarchaeologist Zsófia Kovács with some contributions by Richard Yerkes and the OSU students. 14,220 specimens were collected from contexts at Körösladány-Bikeri, of which 11,108 were mammalian. 2,236 of the mammalian fragments were identifiable to genus or species. 91% of these fragments came from domesticated animals and 9% were wild in origin. Although there are small differences in the distribution of species between Vesztő-Bikeri and Körösladány-Bikeri, Amy Nicodemus and Zsófia Kovács claim that these differences may not be the result of different subsistence strategies, but rather differences in archaeological context. When the material from the Block 4 midden in Vesztő-Bikeri is eliminated from analysis (since no comparable data from midden contexts at Körösladány-Bikeri were collected), there is no significant difference between the two sites, as demonstrated in Figure 4 below (Nicodemus and Kovács in prep).

**Figure 4. Adapted from Nicodemus and Kovács in prep, Figure 10.15 (NISP=4969)**

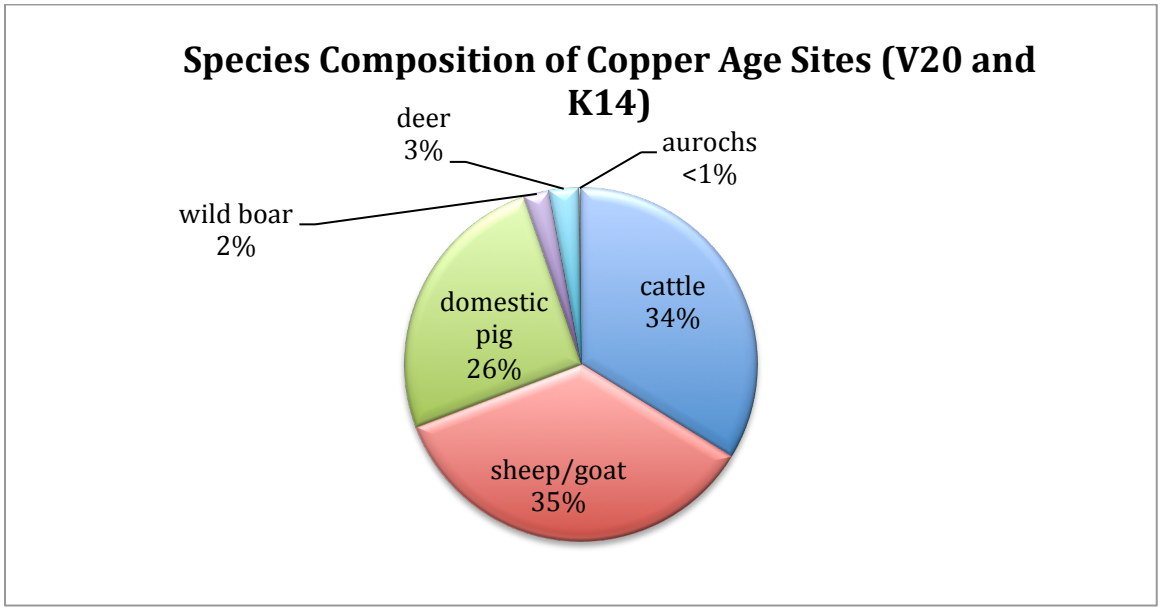



Because of the lack of significant statistical differences between Vesztő-Bikeri and Körörosladany-Bikeri, I have combined the two sites in my statistical analysis. The combined NISP and distribution of the six core species studied in this thesis are presented in Table 3 and Figure 5.

**Table 3. Combined NISP for Vesztő-Bikeri and Körösladány-Bikeri (NISP=4969)**

| Species | NISP | Percent |
|---|---|---|
| Domestic cattle | 1677 | 34% |
| Sheep/goats | 1763 | 35% |
| Domestic pig | 1272 | 26% |
| Wild boar | 116 | 2% |
| Deer | 130 | 3% |
| Aurochs | 11 | <1% |
| Total | 4969 | |

**Figure 5. Combined NISP for Vesztő-Bikeri (V20) and Körösladány-Bikeri (K14, total NISP=4969)**



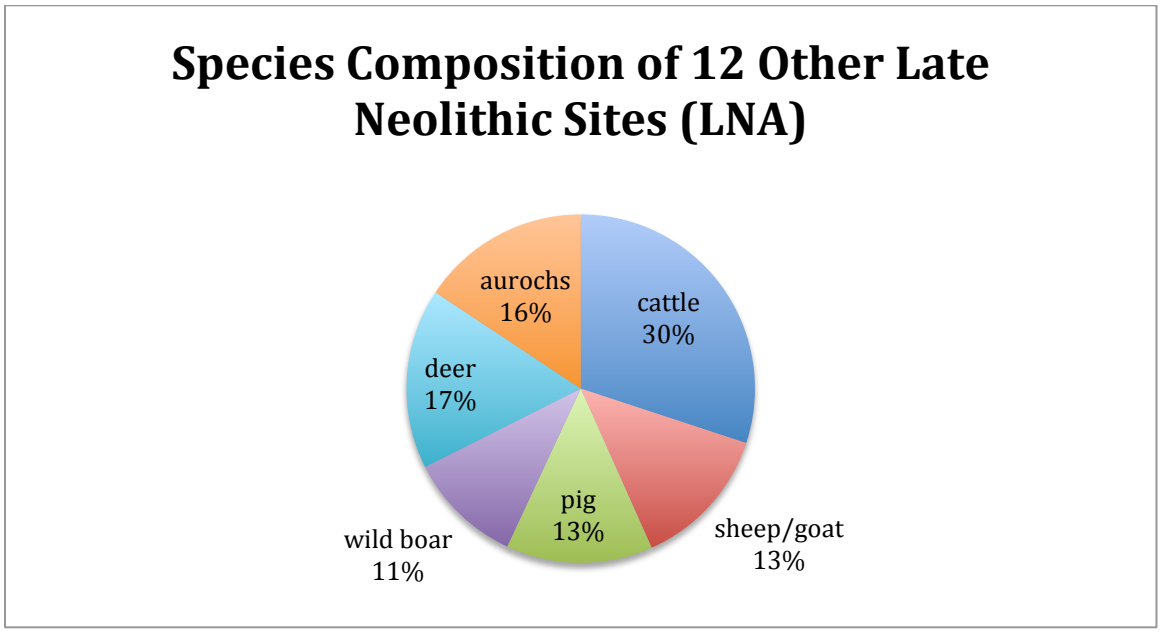

*Other Late Neolithic Sites*

In order to evaluate changes in faunal assemblages broadly over the Neolithic, Bartosiewicz (2005) examined faunal data from 21 Early Neolithic, 20 Middle Neolithic, and 12 Late Neolithic sites. The faunal assemblages from Vésztő-Mágor and Szeghalom-Kovácshalom, which were not included in his analysis, are compared in this thesis to the combined results from the twelve Late Neolithic sites Bartosiewicz studied. These twelve sites include a total of 44,802 faunal specimens. The species distribution is outlined in Table 4 and Figure 6 below (Bartosiewicz 2005).

**Table 4. Species distribution of 12 other Late Neolithic sites (NISP=43,717)**

| Species | Observed | Percent |
|---|---|---|
| Cattle | 13142 | 30% |
| Sheep/goat | 5801 | 13% |
| Pig | 5945 | 14% |
| Wild boar | 4651 | 11% |
| Deer | 7318 | 17% |
| Aurochs | 6860 | 16% |
| Total | 43717 | |

**Figure 6. Species distribution other Late Neolithic sites studied by Bartosiewicz (NISP=43,717)**




Bartosiewicz's material includes a much higher NISP than the NISPs for all the other sites studied in this thesis, which much be considered when interpreting the results of the statistical analysis later in this thesis. Bartosiewicz's high NISP will skew any statistical comparisons of his sites and the other sites studied in this thesis in the direction of his data, either understating or overstating differences between all the sites.

*Szeghalom-Kovácshalom*

The Szeghalom-Kovácshalom site complex (SzK50) lies to the west of a former channel of the Sebes-Körös River and consists of a tell rising 3.5 m above the landscape as well as a surrounding flat area of settlement. The site has a long history of excavation stretching from 1904 to the present. Occupation began during the Middle Neolithic and continued through the Late Neolithic, after which the site was abandoned and then subsequently reoccupied later during the Early Copper Age. Over four spring field seasons from 2010-2013, the Körös Regional Archaeological Project conducted controlled surface collections on the tell and 55 hectares of the

surrounding flat area. Using geophysical imaging techniques, likely areas of occupation were identified on the site and blocks were opened and excavated through the 2013 field season (Yerkes and Parkinson 2013).

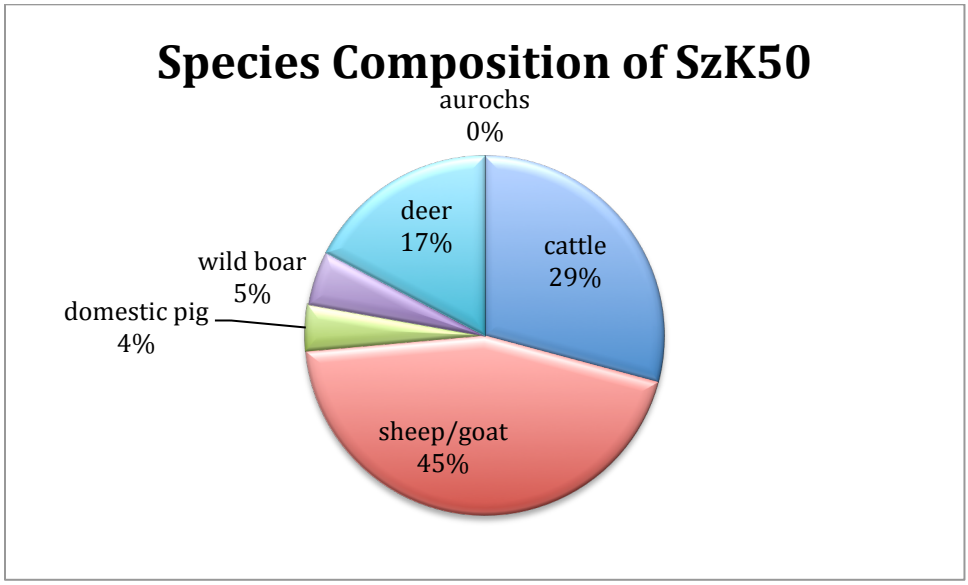
Between 2011 and 2013, 1,464 faunal specimens were recovered from excavations at Szeghalom-Kovácshalom. I identified 897 of these specimens with the assistance of Richard Yerkes. The remainder (567) were identified by OSU student Jackie Lipphardt during a project supported by Fulbright and NSF-IRES funding under the supervision of Dr. Richard Yerkes and Dr. László Bartosiewicz. Only the two fragments of horse bones were considered to possibly have been intrusive, and were not included in the analysis.

**Table 5. Species Composition of SzK50 (NISP=144)**

| Species | NISP | Percent |
|---|---|---|
| Domestic cattle | 42 | 29% |
| Sheep/goats | 64 | 44% |
| Domestic pig | 6 | 4% |
| Wild boar | 7 | 5% |
| Deer | 25 | 17% |
| Aurochs | 0 | 0% |
| Total | 144 | |

Of the 1464 specimens, only 171 were identifiable to genus or species, reflecting the fragmented nature of the remains. 144 of these specimens represent the six species studied in this thesis, and 167 were divisible into categories of domestic and wild specimens. 68% of these 167 specimens were identified as domestic with the remaining 32% representing wild specimens. The distribution of the six core species is outlined in Table 5 and Figure 7.

**Figure 7. Species Composition of Szk50 (NISP=144)**




Because I was interested in comparing Szeghalom-Kovácshalom to other sites, I wanted to know if our data was distributed evenly across features. I was concerned that data distributed unevenly across features may not be representative of the site as a whole, especially considering our relatively small NISP compared to the other sites in my analysis. Therefore, I divided all the faunal material that was identifiable as either wild or domestic (including species other than the six species constituting the bulk of the analysis in this thesis, NISP=167) into three categories: specimens associated with pits and postholes, those associated with structures, and those located away from features or in other contexts. I then conducted a chi square test in order to investigate any significant differences between the number of wild versus domestic specimens from different cultural contexts.

**Table 6. Chi square table of species distribution by feature type at SzK50 (NISP=167)**

| | Pits and postholes | | Longhouses | | Other | | Total |
|---|---|---|---|---|---|---|---|
| **Species** | **Observed** | **Expected** | **Observed** | **Expected** | **Observed** | **Expected** | |
| **Domestic** | 25 | 20 | 5 | 3 | 84 | 90 | 114 |
| **Wild** | 5 | 10 | 0 | 2 | 48 | 42 | 53 |
| **Total** | 30 | | 5 | | 132 | | 167 |

The chi square test ($x^2 = 3.33$, T(.05)=5.99, DF = 2) revealed no relationship between wild or domestic species and context. In other words, wild specimens were no more statistically likely to be found by a certain feature type than domestic specimens, and vice versa. Assuming that different types of features are distributed evenly across the site, a factor other than feature type controls the species found at a particular location. Therefore, I feel comfortable using our data, though small in quantity, as a representative sample of the faunal material at Szeghalom-Kovácshalom. I did not include fish and birds in my analusis because I will not be discussing them in this thesis. Additionally, they were not common in the analyzed data from Szeghalom-Kovácshalom used in this study since remains from flotation samples have not been identified at this time.

## III. Analysis of Spatial Variation in Faunal Assemblages

*Species Composition On-Tell and Off-Tell at Szeghalom-Kovácshalom*

Although there is very little evidence for any social differentiation during the Late Neolithic in the Carpathian Basin, variations in the faunal assemblages on and off the tell at Szeghalom-Kovácshalom could indicate subtle differences in social status. Wild animals and wild boar in particular held symbolic significance in the lives of Late Neolithic people, and in rare cases, are sometimes found in burial assemblages (Giblin 2011). Therefore, I conducted a

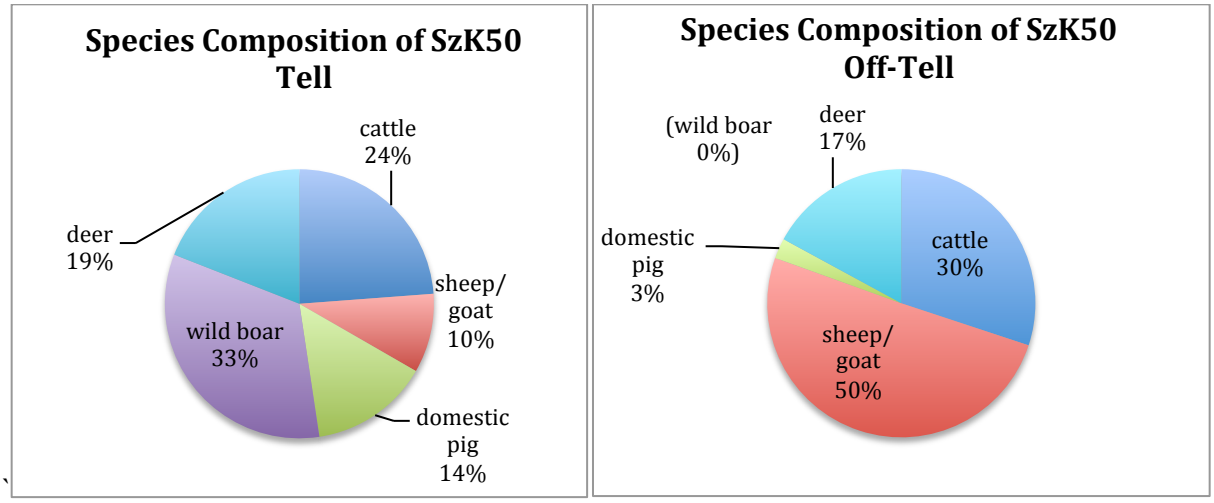
chi square analysis of the distribution of the six core species at Szeghalom-Kovácshalom on and off the tell, excluding aurochs because no specimens were found at SzK50.

**Table 7. Chi square table, tell v. off-tell contexts at SzK50 (NISP=144)**

| | SzK50 Tell | | Off-tell | | |
|---|---|---|---|---|---|
| **Species** | **Observed** | **Expected** | **Observed** | **Expected** | **Total** |
| Cattle | 5 | 6 | 37 | 36 | 42 |
| Sheep/goat | **2** | 9 | **62** | 55 | 64 |
| Domestic pig | 3 | 1 | 3 | 5 | 6 |
| Wild boar | **7** | 1 | **0** | 6 | 7 |
| Deer | 4 | 4 | 21 | 21 | 25 |
| **Total** | 21 | | 123 | | 144 |

The chi square test ($x^2 = 52.44$, T(.05)=9.488, $p \leq .05$, DF=4) revealed significant differences between the species represented on and off the tell. I have marked the anomalous data in the above table. Red font represents lower than expected values and green font represents higher than expected values. There were no significant differences in the frequencies of domestic cattle, domestic pig, or deer, but significant differences were found in the frequencies of wild boar and sheep/goat. A preponderance of wild boar on the SzK50 tell suggests that its possession and consumption was possibly restricted to the tell populations. The distribution of sheep/goat on and off the tell is similarly dramatic. Only two sheep/goat specimens were found on the tell, and sixty-two were found in off-tell contexts. Combined with the wild boar data, we can generalize that significantly more wild animals were found on the tell than off it and that there may be some social component that explains this difference.

**Figure 8. Species composition, tell v. off-tell context at SzK50 (NISP=144)**




*Species Composition of Vésztő-Mágor and the SzK50 Tell*

Because of the relatively small number of specimens representing the six core species found on the Szeghalom-Kovácshalom tell (NISP = 21), I wanted to know if combining the data from Vésztő-Mágor with the SzK50 tell data would yield a larger sample that would enable a more reliable comparison to the off-tell area of Szeghalom-Kovácshalom. Therefore, I conducted a chi square test looking for significant differences between the two assemblages.

**Table 8. Chi square table comparing Vésztő-Mágor and the SzK50 tell (NISP=203)**

| | **Vésztő-Mágor** | | **SzK50 Tell** | | |
|---|---|---|---|---|---|
| **Species** | **Observed** | **Expected** | **Observed** | **Expected** | **Total** |
| Cattle | 68 | 65 | 5 | 8 | 73 |
| Sheep/goat | 24 | 23 | 2 | 3 | 26 |
| Domestic pig | 26 | 26 | 3 | 3 | 29 |
| Wild boar | 43 | 45 | 7 | 5 | 50 |
| Deer | 16 | 14 | 4 | 2 | 20 |
| Aurochs | 5 | 4 | 0 | 1 | 5 |
| **Total** | 182 | | 21 | | 203 |

The results of my test ($x^2 = 6.06$, T(.05)=11.07, DF = 5) revealed no significant differences between the composition of the two tells. Because the tells were occupied

contemporaneously during the Late Neolithic and stood merely 7 km apart, the lack of significant differences between the tells is strong evidence for a cultural pattern of species distribution on tells. Although the NISP of 21 (six core species only) at the SzK50 tell is relatively low compared to the NISP of 182 at Vésztő-Mágor, I believe that the result of the chi square test still stands and that I can conclusively say that there is no significant difference between the tells. This statement is supported by my former assertion that the species at Szeghalom-Kovácshalom are evenly distributed over different features and thus are representative of the site as a whole.

*Species Composition On-Tell v. Off-Tell*

Because no significant differences were discovered between the SzK50 tell and Vésztő-Mágor, I combined the two assemblages and then compared them against the off-tell Szeghalom-Kovácshalom material in order to investigate differences in faunal distribution on tell and off-tell contexts. The combination of the tell material as compared to the off-tell material produced Table 9 below. Statistically significant values are highlighted, with green font representing higher than expected frequencies and red font representing lower than expected frequencies.

**Table 9. Chi square table, SzK50 tell and Vésztő-Mágor v. SzK50 off-tell (NISP=326)**

| | **Tells** | | **Off-tell** | | |
|---|---|---|---|---|---|
| **Species** | **Observed** | **Expected** | **Observed** | **Expected** | **Totals** |
| Cattle | 73 | 68 | 37 | 42 | 110 |
| Sheep/goat | **26** | 55 | **62** | 33 | 88 |
| Domestic pig | **29** | 20 | **3** | 12 | 32 |
| Wild boar | **50** | 31 | **0** | 19 | 50 |
| Deer | 20 | 26 | 21 | 15 | 41 |
| aurochs | 5 | 3 | 0 | 2 | 5 |
| **Total** | 203 | | 123 | | 326 |

The results of my chi square test comparing the combined tells to the off-tell SzK50 material ($x^2 = 90.30$, T(.05)=11.07, DF = 5) show a relationship between species and location. In

particular, there are significantly fewer sheep and goat and more pig and wild boar represented on the tells than off. These results support and align with my comparison of the SzK50 on and off-tell material, other than the higher frequency of domestic pigs on tells. This data is anomalous, especially considering that when only the SzK50 tell and off-tell areas were compared, there was no significant difference in the frequency of domestic pigs on versus off tell. Additionally, there was no significant difference in the frequency of domestic pigs between the SzK50 tell and Vésztő-Mágor. This incongruity can only be explained through further investigation.

*Other Late Neolithic Sites v. Szeghalom-Kovácshalom*

I conducted another chi square test comparing the species frequencies in Bartosiewicz's Late Neolithic dataset to the frequencies at Szeghalom-Kovácshalom. Bartosiewicz drew his data from twelve Late Neolithic sites, using it as representative of the era as a whole. Therefore it would be useful to know if our data from Szeghalom-Kovácshalom fits into Bartosiewicz's dataset and upholds his observations about changes in faunal assemblages between the Early, Middle, and Late Neolithic and the Copper Age. However, the size of Bartosiewicz's dataset dwarfs the dataset from Szeghalom-Kovácshalom. The NISP for the 12 Late Neolithic sites Bartosiewicz studied numbers 43,717 whereas the SzK50 NISP numbers merely 144 (Bartosiewicz 2005). I will present the results of my chi square test, but caution that in this case the test is not a reliable means of assessing similarities and differences between the two samples. Bartosiewicz uses far more data than we have collected from SzK50, compromising the integrity of my results. Table 10 presents my chi square analysis. Like in Table 9, green font corresponds to higher than expected frequencies of a species and red font corresponds to lower than expected frequencies.

**Table 10. Chi square table, 12 other Late Neolithic Sites v. SzK50 (NISP=43,861)**

| | Other Late Neolithic | | SzK50 | | |
|---|---|---|---|---|---|
| **Species** | **Observed** | **Expected** | **Observed** | **Expected** | **Totals** |
| Cattle | 13142 | 13141 | 42 | 43 | 13184 |
| Sheep/goat | 5801 | 5846 | **64** | 19 | 5865 |
| Pig | 5945 | 5931 | **6** | 20 | 5951 |
| Wild boar | 4651 | 4752 | 7 | 15 | 4658 |
| Deer | 7318 | 7319 | 25 | 24 | 7343 |
| Aurochs | 6860 | 6837 | **0** | 23 | 6860 |
| **Total** | 43717 | | 144 | | 43861 |

My chi square test ($x^2 = 145.36$, T(.05)=11.07, DF = 5) reveals that there are significant differences between the 12 other Late Neolithic sites and our sample from Szeghalom-Kovácshalom. In particular, the numbers of sheep and goat are higher than expected in the SzK50 sample, and numbers of pig and aurochs are lower than expected. However, I caution against the reliability of these results considering that the test compared two NISPs of 144 and 43,717. Due to the gross difference between the two NISPs, I recommend discounting Bartosiewicz's data for the remainder of this study.

## IV. Analysis of Temporal Variation in Faunal Assemblages

*Szeghalom-Kovácshalom v. Vesztő-Bikeri*

Vesztő-Bikeri is the earlier of the two Copper Age sites discussed in this thesis, and therefore will be compared against our Late Neolithic data first in order to illuminate any small changes between faunal assemblages during the transition from the Neolithic to the Copper Age. The importance of domesticates purportedly increased during the Copper Age, and thus, I would expect to see a greater number of wild animals in the Late Neolithic sample than in the Copper Age sample (Giblin 2011). Additionally, if wild animals were associated with tells in the Late

Neolithic, the absence of tells in Copper Age samples would cause the frequency of wild species in an assemblage to drop.

**Table 11. Chi square table, SzK50 v. Vesztő-Bikeri (NISP=3041)**

| | SzK50 | | Vesztő-Bikeri | | | |
|---|---|---|---|---|---|---|
| **Species** | **Observed** | **Expected** | **Observed** | | **Expected** | **Totals** |
| Cattle | 42 | 54 | 1093 | | 1081 | 1135 |
| Sheep/goat | **64** | 49 | 973 | | 988 | 1037 |
| Domestic pig | **6** | 35 | 731 | | 702 | 737 |
| Wild boar | **7** | 2 | 27 | | 32 | 34 |
| Deer | **25** | 4 | **65** | | 86 | 90 |
| Aurochs | 0 | 0 | 8 | | 9 | 8 |
| **Total** | 144 | | 2897 | | | 3041 |

The results of my chi square test ($x^2 = 161.48$, T(.05)=11.07, DF = 5) confirm my hypothesis. There are fewer domestic pig, more wild boar, more sheep and goats, and more deer than expected in the Szeghalom-Kovácshalom sample. This supports the theory that hunting was more important in the Late Neolithic than in the Copper Age and that domestication increased in importance in the latter period. However, there are more sheep and goats than expected in the Szeghalom-Kovácshalom assemblage. A possible explanation posits the return of Balkan animal husbandry in reaction to an environmental or social threat after an initial shift away from ancestral traditions during the Middle Neolithic.

*Szeghalom-Kovácshalom v. Vesztő-Bikeri and Körösladány-Bikeri*

Because I found no significant differences between Vesztő-Bikeri and Körösladány-Bikeri, I decided to combine the samples from the two sites and compare it to the Szeghalom-Kovácshalom data in an attempt to elucidate larger patterns of change between the Late Neolithic and the Copper Age. The combined NISP (six core species only) for Vesztő-Bikeri and

Körösladány-Bikeri is 4,969. A chi square test of the two Copper Age sites against SzK50 yields Table 12 below.

**Table 12. Chi square table, SzK50 v. Vesztő-Bikeri (V20) and Körösladány-Bikeri (K14) (NISP=5113)**

| | SzK50 | | V20 and K14 | | |
|---|---|---|---|---|---|
| **Species** | **Observed** | **Expected** | **Observed** | **Expected** | **Totals** |
| Cattle | 42 | 48 | 1677 | 1671 | 1719 |
| Sheep/goat | **64** | 51 | 1763 | 1776 | 1827 |
| Domestic pig | **6** | 36 | 1272 | 1242 | 1278 |
| Wild boar | **7** | 3 | 116 | 120 | 123 |
| Deer | **25** | 4 | 130 | 151 | 155 |
| Aurochs | 0 | 0 | 11 | 11 | 11 |
| **Total** | 144 | | 4969 | | 5113 |

The chi square test ($x^2 = 148.54$, T(.05)=11.07, DF = 5) yields nearly the exact same results as the test comparing SzK50 to Vesztő-Bikeri alone. There are more sheep and goats, wild boar, and deer present than expected in the Late Neolithic sample, and fewer domestic pig. Here I offer the same explanation I offered for my comparison of the Vesztő-Bikeri sample against SzK50. Domestication increased in the Copper Age, so more wild animals would accordingly be found in the Late Neolithic sample. The Tiszapolgár's shift away from sheep and goat husbandry and to the domestication of locally available animals such as wild boar and aurochs also explains my results.

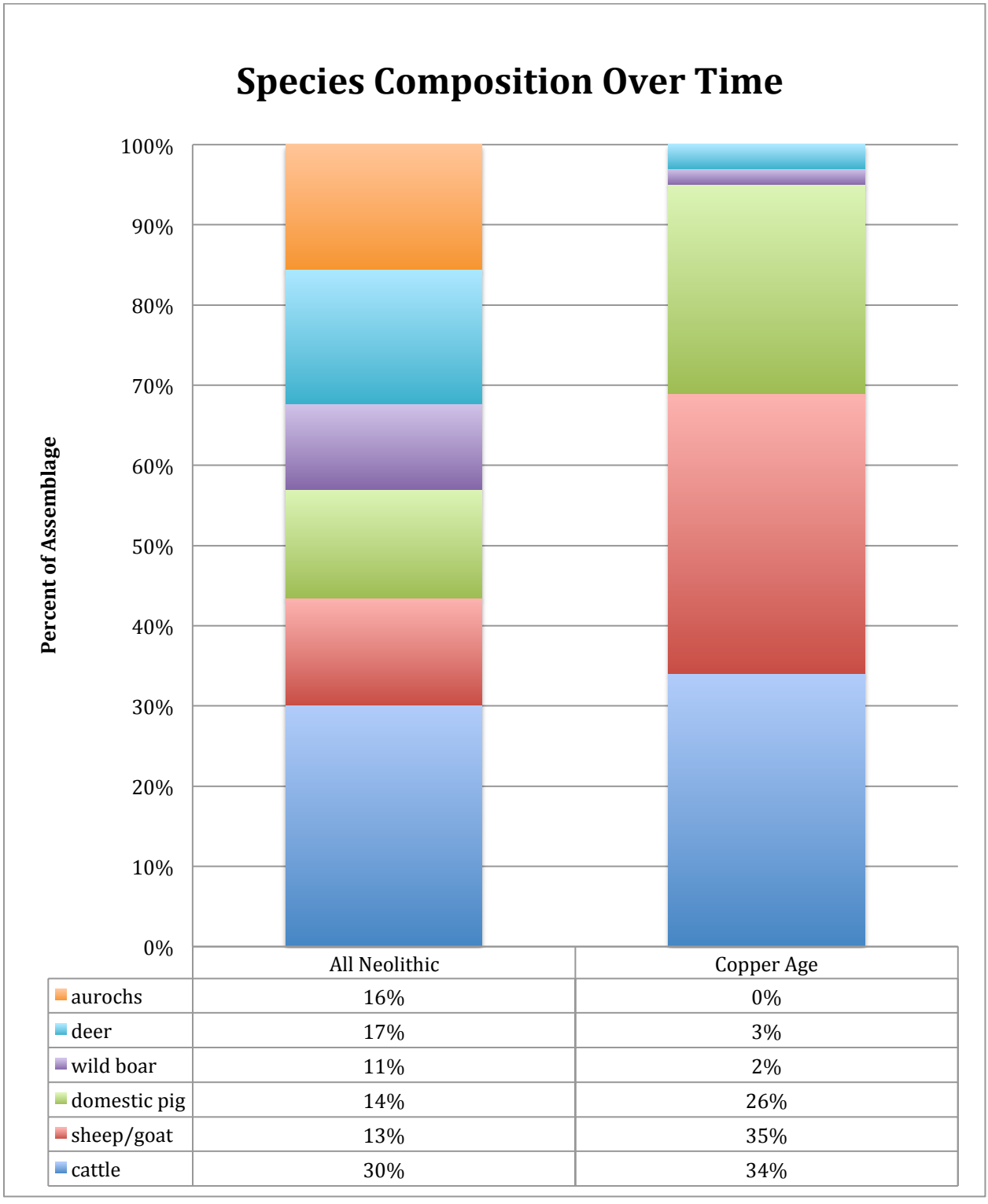
*Neolithic Sites v. Copper Age Sites*

In an attempt to compare the data discussed in this thesis to broad generalizations made about the changes in faunal assemblages from the Neolithic to the Copper Age such as those found in Parkinson 1999, Giblin 2011, and Bartosiewicz 2005, I combined the sum of the Late Neolithic sites (including those studied by Bartosiewicz) and compared them to the sum of the Copper Age sites to produce Figure 9. It provides a visual depiction of changes in species

composition over time. Overall, the abundance of wild species decreased in the Copper Age, including aurochs, deer and wild boar. In addition, the number of domesticated specimens rose between the Neolithic and the Copper Age. While the percentages of cattle in the Late Neolithic and the Copper Age are quite similar (30% and 34% respectively), the frequency of domestic pig rises significantly between the two periods.

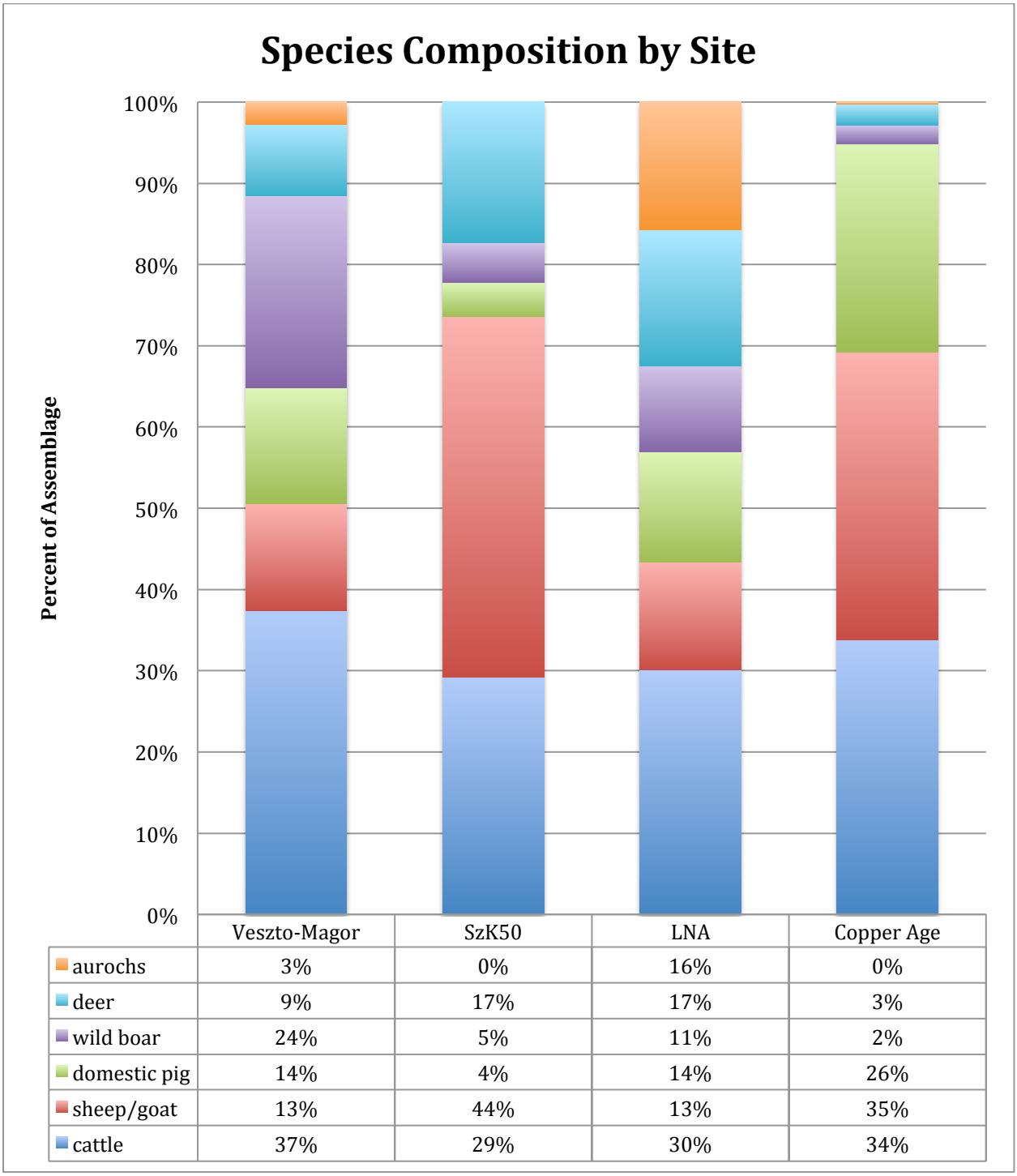
The only anomalous piece of data is the rise in frequency of sheep and goats in the Copper Age. This component does not fit my previous hypothesis that the Tiszapolgár culture of the Early Copper Age stopped raising sheep and goats in such high numbers and intensified domestication of locally available species. However, it does fit the hypothesis proposed by other members of the archaeological community that domestic animals rose generally in abundance in the Copper Age (Parkinson 1999, Giblin 2011, Bartosiewicz 2005). I attribute the rise in sheep and goats to the volume of Bartosiewicz's Late Neolithic data. Bartosiewicz's data makes up the bulk of the Neolithic material portrayed in the above chart, and as previously discussed, there are significantly fewer sheep and goats than would be expected in it. This dearth of ovicaprids would massively affect the total Late Neolithic sample, underrepresenting the importance of sheep and goats in the much smaller SzK50 and Vésztő-Magor Late Neolithic assemblages. Figure 10 illustrates this in graphic terms. Whereas sheep and goats comprise 44% of the SzK50 assemblage, they only comprise 13% of the data Bartosiewicz collected. Although sheep and goats also make up only 13% of the assemblage of Vésztő-Mágor, the low NISP of Vésztő-Mágor as compared to the high NISP of Bartosiewicz's sites (termed LNA in Figure 10) would have very little, if any, effect on the data.

**Figure 9. Species composition over time (NISP=49,012)**




| | All Neolithic | Copper Age |
|---|---|---|
| aurochs | 16% | 0% |
| deer | 17% | 3% |
| wild boar | 11% | 2% |
| domestic pig | 14% | 26% |
| sheep/goat | 13% | 35% |
| cattle | 30% | 34% |

**Figure 10. Species composition by site (NISP=49,012)**




| | Veszto-Magor | SzK50 | LNA | Copper Age |
|---|---|---|---|---|
| aurochs | 3% | 0% | 16% | 0% |
| deer | 9% | 17% | 17% | 3% |
| wild boar | 24% | 5% | 11% | 2% |
| domestic pig | 14% | 4% | 14% | 26% |
| sheep/goat | 13% | 44% | 13% | 35% |
| cattle | 37% | 29% | 30% | 34% |

## V. Conclusions

To summarize the statistical analyses I discuss in this thesis, despite small sample sizes at SzK50 and Vésztő-Magor, I discovered that:

1. There are significant patterns of species distribution at Szeghalom-Kovácshalom. Specifically, there are fewer sheep and goat and more wild boar than expected on the tell. This pattern holds even when the data from Vésztő-Mágor is added to the data from the Szeghalom-Kovácshalom tell.
2. There are no significant differences between the faunal assemblages from the Szeghalom-Kovácshalom tell and from Vésztő-Mágor tell.
3. Szeghalom-Kovcshalom's assemblage is composed of more deer, more wild boar, more sheep and goat, and fewer domestic pig than expected when compared to the combined Copper Age sites.

I propose that the spatial variation in the faunal assemblages studied here can be explained by a degree of social differentiation during the Late Neolithic. Other evidence for social differentiation in southeast Europe during the Late Neolithic is not nonexistent. For example, although there was little variation in grave goods during the Late Neolithic (Duffy 2010), Raczky et al. (2002) note that at the tell site of Polgár-Csöszhalom, wild boar tusks, mandibles, deer teeth, and other wild faunal remains were present in some burials but not in others and differed in distribution by gender. The authors concluded that wild animals and their associated products must have been prestige items on the Great Hungarian Plain during that period, and that hunting and possession of these prestige items may have been a luxury of those at the apex of the social hierarchy. A similar phenomenon may have occurred at Szeghalom-Kovácshalom, reflected in the more concentrated distribution of wild fauna on tells.

Furthermore, if tells were associated with some sort of social hierarchy, the abandonment of tells at the end of the Neolithic may represent a rejection of social differentiation, further evidenced by the increases in domestic specimens in the Copper Age assemblages studied here.

Differences in social standing are the only valid explanation at the present of the statistically significant variation in fauna on and off the tell at Szeghalom-Kovácshalom. A previously discussed chi square test ($x^2 = 3.33$, T(.05)=5.99, DF = 2) revealed that wild and domestic fauna were evenly distributed across the site's features. In other words, a wild specimen was no more likely to be found be a type of feature, such as a pit or posthole, than a domestic specimen. Therefore, the preponderance of wild animals on the tell at Szeghalom-Kovácshalom cannot be explained by a relationship between feature type and species, assuming features are distributed homogenously across the site. According to Yerkes et al. (2009), the tell and the off-tell area were also occupied simultaneously and thus do not represent different phases in site occupation. Summed probabilities from the 11 radiocarbon dates taken from the tell are 4836-5071 B.C. calibrated. Yerkes et al. (2009) claim that these dates overlap with most of the dates from the off-tell areas of SzK50. Raczky et al. (2002) proposed that a similar pattern of faunal distribution at Polgár-Csöszhalom was due to ritual activities performed on the tell and everyday activities performed on the surrounding flat area. Further study of the distribution of species by feature at Szeghalom-Kovácshalom could investigate the validity of this hypothesis at the site.

A degree of social hierarchy on the Great Hungarian Plain during the Late Neolithic also explains the differences in settlement layout between Szeghalom-Kovácshalom and Vésztő-Mágor. As previously discussed, although the tell at Szeghalom-Kovácshalom was surrounded by a flat settlement area, Vésztő-Mágor was not (Parkinson 1999). Considering the large size of

the Vésztő-Mágor tell compared to the Szeghalom-Kovácshalom tell (3.5 meters in height versus 9), the significantly larger, and therefore symbolically more important, Vésztő-Mágor tell may have served as a sort of regional center occupied only by elites. The Szeghalom-Kovácshalom tell may have served as smaller satellite center emulating the diet and subsistence practices of Vésztő-Mágor in an attempt to exert symbolic and psychological power over the off-tell area.

Settlement organization may have facilitated the development of a degree of social hierarchy during the Late Neolithic and its dissolution during the Early Copper Age. During the Late Neolithic, the Tisza lived in large, multi-roomed longhouses with their own cooking and butchering facilities. However, during the Early Copper Age, the size of structures decreased. Food preparation became a community activity, and butchering and cooking facilities were shared by everyone in a settlement (Parkinson, Yerkes, and Gyucha 2004). Early Copper Age societies functioned as "economically integrated units" (Parkinson, Yerkes, and Gyucha 2004:104) that worked together to make a living, procuring and preparing food as a group, much like hunter-gatherer societies. Because food preparation during the Late Neolithic was not a communal activity, variation and competition between families and social groups may have developed, leading to subtle social differentiation. The Tiszapolgár of the Early Copper Age, however, could not afford the tensions that would have developed as a result of social differentiation. People had become "increasingly interdependent upon each other for basic economic and social needs" and would have been unable invest the time and energy into competition, not to mention withstand the repercussions of alienating others on whom they depended for subsistence (Parkinson, Yerkes, Gyucha 2004:107). Parkinson, Yerkes, and Gyucha (2004) believe that the interdependency of Early Copper Age peoples prohibited the development of a social hierarchy. It is thus logical that the independency of peoples living in

Late Neolithic settlements would not have hindered, and if anything encouraged, the development of such a hierarchy.

Of course, the faunal material discussed here cannot stand alone as evidence for a degree of social hierarchy on the Great Hungarian Plain during the Late Neolithic. Further study is needed to augment and validate the conclusions I draw in this thesis. Although the material at Vésztő-Mágor was separated by time period, it is not currently separated by context or excavation unit, at least in English. Translation and interpretation of Hegedűs's records could reveal differences in assemblage composition by context on Vésztő-Mágor. Bioarchaeological studies of diet could also illuminate social differentiation. Although Giblin (2011) analyzed strontium, carbon, and nitrogen isotope ratios to study diet and mobility in the Late Neolithic and Copper Age in her 2011 dissertation, she did not collect enough samples from the sites discussed in this thesis for me to use them in my analysis. Further studies could use Giblin's data in combination with new isotopic data to study the social status of particular individuals, looking for relationships between burial assemblages and carbon and nitrogen isotopic ratios. Additionally, a thorough analysis of the burial assemblages at Szeghalom-Kovácshalom, like that conducted at Polgár-Csöszhalom, could be a valuable tool in further investigations. Differences in grave goods, particularly differences in off and on tell grave goods, could either refute or support my conclusions. Finally, floatation samples were collected from Szeghalom-Kovácshalom during the 2013 field season, but have not yet been analyzed. These samples may yield substantial numbers of fish and bird bones, which could add another layer to the faunal analysis of the site.

Overall, I believe that the patterns of subsistence observed at Vésztő-Mágor and Szeghalom-Kovácshalom suggest a much more complex and differentiated society in the Late

Neolithic Tisza culture than previously believed. Distinct differences in the faunal assemblages on and off tells indicate variations in status in what is generally thought of as a relatively egalitarian society. Although these variations may be small, they are not insignificant. In conclusion, the abandonment of tells at the end of the Neolithic and a shift to more intensive domestication in the Early Copper Age may represent a rejection of a degree of social differentiation apparent at tell settlements, further complicating our understanding of the social dynamics of middle range societies.

**Bibliography**

Bánffy, Eszter
1994 Transdanubia and Eastern Hungary in the Early Copper Age. A Jósa András Múzeum Évkönyve XXXVI:291-296.

Bartosiewicz, László
2005 Plain talk: animals, environment and culture in the Neolithic of the Carpathian Basin and adjacent areas. *In* (Un)settling the Neolithic. Douglass W. Bailey, Alasdair Whittle, and Vicki Cummings, eds. Pp. 51-63. Oxford: Oxbow.

Beja-Pereira, Albano, David Caramelli, Carles Lalueza-Foxe, Cristiano Vernesi, Nuno Ferranda, Antonella Casoli, Felix Goyache, Luis J. Royo, Serena Conti, Martina Lari, Andrea Martini, Lahousine Ouragh, Ayed Magid, Abdulkarim Atash, Attila Zsolnai, Paolo Boscato, Costas Triantaphylidis, Konstantoula Ploumi, Luca Sineo, Francesco Mallegni, Pierre Taberlet, Georg Erhardt, Lourdes Sampietro, Jaume Bertranpetit, Guido Barbujani, Gordon Luikartb, and Giorgio Bertorelle
2006 The origin of European cattle: Evidence from modern and ancient DNA. Proceedings of the National Academy of Sciences of the United States of America 103 (21):8113–8118.

Bradley, Daniel G.
2006 Genetics and the origins of domestic cattle. *In* Documenting Domestication. Melinda A. Zeder, Eve Emshwiller, Bruce D. Smith, and Daniel G. Bradley, eds. Pp. 317-328. Berkeley: University of California Press.

Cymbron, Teresa, Abigail R. Freeman, M. Isabel Malheiro, Jean-Denis Vigne, and Daniel G. Bradley
2005 Microsatellite diversity suggests different histories for Mediterranean and Northern European cattle populations. Proceedings of the Royal Society for Biological Sciences 272(1574):1837-1843.

Davis, Simon J.M.
1987 The Archaeology of Animals. New Haven: Yale University Press.

Duffy, Paul R.
2010 Complexity and Autonomy in Bronze Age Europe: Assessing Cultural Developments in Eastern Hungary. Ph.D. thesis. Anthropology Department, University of Michigan, Ann Arbor.

Edwards, Ceiridwen J., Ruth Bollongino, Amelie Scheu, Andrew Chamberlain, Anne Tresset, Jean-Denis Vigne, Jillian F. Baird, Greger Larson, Simon Y.W. Ho, Tim H. Heupink, Beth Shapiro, Abigail R. Freeman, Mark G. Thomas, Rose-Marie Arbogast, Betty Arndt, László Bartosiewicz, Norbert Benecke, Mihael Budja, Louis Chaix, Alice M. Choyke, Eric Coqueugniot, Hans-Jürgen Döhle, Holger Göldner, Sönke Hartz, Daniel Helmer, Barabara Herzig, Hitomi Hongo, Marjan Mashkour, Mehmet Özdogan, Erich Pucher, Georg Roth, Sabine

Schade-Lindig, Ulrich Schmölcke, Rick J. Schulting, Elisabeth Stephan, Hans-Peter Uerpmann, István Vörös, Barbara Voytek, Daniel G. Bradley, and Joachim Burger
2007 Mitochondrial DNA analysis shows a Near Eastern Neolithic origin for domestic cattle and no indication of domestication of European aurochs. Proceedings of the Royal Society for Biological Sciences 274(1616):1377-1385.

Fernández, Helena, Sadrine Hughes, Jean-Denis Vigne, Daniel Helmer, Greg Hodgins, Christian Miquel, Catherine Hänni, Gordon Luikart, and Pierre Taberlet
2006 Divergent mtDNA lineages of goats in an Early Neolithic site, far from the initial domestication areas. Proceedings of the National Academy of Sciences of the United States of America 103(42):15375-15379.

Giblin, Julia I.
2011 Isotope Analysis on the Great Hungarian Plain: An Exploration of Mobility and Subsistence Strategies from the Neolithic to the Copper Age. Ph.D. thesis. Department of Anthropology, The Ohio State University, Columbus.

Gyulai, Ferenc
1993 Environment and Agriculture in Bronze Age Hungary. Archaeolingua. Budapest: Archaeological Institute of the Hungarian Academy of Sciences.

Hegedűs, Katalin
1977 A Vésztö Mágori-dombi ujkőkori és rézkori temetkezések, Bölcsészdoktori értekezés.

Hegedűs, Katalin, and József Makkay
1987 Véstzö-Mágor: a settlement of the Tisza culture. *In* The Late Neolithic of the Tisza region: a survey of recent excavations and their findings. Pál Raczky, ed. Pp. 85-1 04. Budapest-Szolnok: Szolnok County Museums.

Kalicz, Nandor, and Pál Raczky
1987 The Late Neolithic of the Tisza Region: a survey of recent archaeological research. *In* The Late Neolithic of the Tisza region: a survey of recent excavations and their findings. Pál Raczky, ed. Pp. 11-29. Budapest-Szolnok: Szolnok County Museums.

Kertész, Róbert
1996 The Mesolithic in the Great Hungarian Plain: A survey of the evidence. *In* At the Fringes of Three Worlds: Hunter-Gatherers and Farmers in the Middle Tisza Valley. László Tálas, ed. Pp. 5-34. Szolnok: Damjanich Museum Press.

Kertész, Róbert, and Pál Sümegi
2001 Theories, Critique and a Model: Why did the expansion of the Koros-Starcevo Culture stop in the centre of the Carpathian Basin? *In* From the Mesolithic to the Neolithic: Proceedings of the International Archaeological Conference held in the Damjanich Museum of Szolnok. Pp. 225-246. Budapest: Archaeolingua.

Kovács, Zsófia, and Erika Gál
2009 Animal remains from the site of Öcsöd–Kováshalom. *In* In Ten Years After: The Neolithic of the Balkans, as Uncovered by the Last Decade of Research. Florin Draşovean, Dan Leopold Ciobotaru, and Margaret Maddison, eds. Pp. 152-157. Timişoara: Editura Marineasa.

Larson, Greger, Keith Dobney, Umberto Albarella, Meiying Fang, Elizabeth Matisoo-Smith, Judith Robins, Stewart Lowden, Heather Finlayson, Tina Brand, Eske Willerslev, Peter Rowley-Conwy, Leif Andersson, and Alan Cooper
2005 Worldwide Phylogeography of Wild Boar Reveals Multiple Centers of Pig Domestication. Science 307(5715):1618-1621.

Larson, Greger, Umberto Albarella, Keith Dobney, Peter Rowley-Conwy, Jörg Schibler, Anne Tresset, Jean-Denis Vigne, Ceiridwen J. Edwards, Angela Schlumbaum, Alexandru Dinu, Adrian Bălăçsescu, Gaynor Dolman, Antonio Tagliacozzo, Ninna Manaseryan, Preston Miracle, Louise Van Wijngaarden-Bakker, Marco Masseti, Daniel G. Bradley, and Alan Cooper
2007 Ancient DNA, pig domestication, and the spread of the Neolithic into Europe. Proceedings of the National Academy of Sciences of the United States of America 104(39):15276-15281.

Luikart, Gordon, Helena Fernández, Marjan Mashkour, Phillip R. England, and Pierre Taberlet
2006 Origins and diffusion of domestic goats inferred from DNA markers. *In* Documenting Domestication. Melinda A. Zeder, Eve Emshwiller, Bruce D. Smith, and Daniel G. Bradley, eds. Pp. 294-305. Berkeley: University of California Press.

Makkay, József
1996 Theories about the origin, the distribution and the end of the Körös Culture. *In* At the Fringes of Three Worlds: Hunter-Gatherers and Farmers in the Middle Tisza Valley. László Tálas, ed. Pp. 35-49. Szolnok: Damjanich Museum Press.

Milisauskas, Sarunas, and Janusz Kruk
2002 Middle Neolithic Continuity, Diversity, Innovations, and Greater Complexity, 5500/5000-3500/3000 BC. *In* European Prehistory: A Survey. Sarunas Milisauskas, ed. Pp. 193-269. New York: Kluwer Academic/Plenum Publishers.

Naderi, Saeid, Hamid-Reza Rezaei, François Pompanon, Michael G.B. Blum, Riccardo Negrini, Hamid-Reza Naghash, Özge Balkız, Marjan Mashkour, Oscar E. Gaggiotti, Paolo Ajmone-Marsan, Aykut Kence, Jean-Denis Vigne, and Pierre Taberlet
2008 The goat domestication process inferred from large-scale mitochondrial DNA analysis of wild and domestic individuals. Proceedings of the National Academy of Sciences of the United States of America 105(46):17659-17664.

Nicodemus, Amy, and Zsófia Kovács
In prep The Faunal Assemblages. *In* Bikeri: Two Copper Age Villages on the Great Hungarian Plain. William A. Parkinson, ed. Los Angles: Costen Institute of Archaeology.

Parkinson, William A.
1999 The Social Organization of Early Copper Age Tribes on the Great Hungarian Plain. Ph. D. thesis. Anthropology Department, University of Michigan, Ann Arbor.

Parkinson, William A., Richard Yerkes, and Attila Gyucha
2004 The Transition to the Copper Age on the Great Hungarian Plain: The Körös Regional Archaeological Project Excavations at Vészto-Bikeri and Körösladány- Bikeri, Hungary, 2000-2002. Journal of Field Archaeology 29(1&2):101-121.

Parkinson, William A., Richard Yerkes, Attila Gyucha, Apostolos Sarris, Margaret Morris, and Roderick Salisbury
2010 Early Copper Age Settlements in the Körös Region of the Great Hungarian Plain. Journal of Field Archaeology 35(2):164-183.

Raczky, Pál , Walter Meier-Arendt, Alexandra Anders, Zsigmond Hajdú, Emese Nagy, Katalin Kurucz, László Domboroczki, Katalin Sebök, Pál Sümegi, Enikö Magyari, Zszsa Szántó, Sándor Gulyás, Katalin Dobó, Erzsébet Bácskay, Katalin Bíró, and Charles Schwartz
2002 Polgár-Csöszhalom (1989-2000): summary of the Hungarian-German excavations on a Neolithic settlement in Eastern Hungary. *In* Mauerschau: Festschrift für Manfred Korfmann. Rüstem Aslan, Stephan Blum, Gabriele Kastl, Frank Schweizer, and Diane Thumm, eds. Pp. 833-860. Remschalden-Brumbach: Greiner.

Sherratt, Andrew
1997 Economy and Society in Prehistoric Europe: Changing Perspectives. Princeton: Princeton University Press.

Soares, Pedro, Alessandro Achilli, Ornella Semino, William Davies, Vincent Macaulay, Hans-Jürgen Bandelt, Antonio Torroni, and Martin B. Richards
2010 The Archaeogenetics of Europe. Current Biology 20(4):R174-R183.

Tálas, László, and Pál Raczky
1987 The Late Neolithic of the Tisza region : a survey of recent excavations and their findings : Hódmezővásárhely-Gorzsa, Szegvár Tűzköves, Öcsöd- Kováshalom, Vésztő-Mágor, Berettyóújfalu-Herpály. Budapest: Kossuth Press.

Whittle, Alasdair
1996 Europe in the Neolithic: The Creation of New Worlds. Cambridge: Cambridge University Press.

Willcox, George
2005 The distribution, natural habitats and availability of wild cereals in relation to their domestication in the Near East: multiple events, multiple centres. Vegetation History and Archaeobotany 14(4):534-541.

Yerkes, Richard W., Attila Gyucha, and William A. Parkinson
2009 A multi-scalar approach to modeling the end of the Neolithic on the Great

Hungarian Plain using calibrated radiocarbon dates. Radiocarbon 51(3):890-932.

Yerkes, Richard, and William A. Parkinson
2013 Major Research and Education Activities. NSF Annual Report, 2011-2012.